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*Report on the Sixth International Statistical Congress. By SAMUEL BROWN, ESQ., F.S.S., President of the Institute of Actuaries.*

[Read before the Institute, 25th November, 1867.]

THE studies of an actuary depend so much for their success on the accurate and full collection of statistics, that we cannot but feel a deep interest in every effort that is made to improve the method of and to lay down sound principles for obtaining them. Hitherto we have been more especially concerned with the laws of population, vitality, and disease, because they form the basis of the vast extension of life assurance in this and other countries. But in the course of the last few years the progress of social science has brought forward many questions to which the doctrine of probability as to the recurrence of events may be applied, which, though not strictly within the limits of our professional pursuits, afford many opportunities for the use and extension of our science.

The Statistical Congresses, of which six have now been held, have been fruitful in results of the highest utility. The object of them has hitherto been to agree upon some uniform method of collecting the facts which show the condition and progress of a nation, whether in its social, commercial, or economical relations, which will enable the true laws to be discovered by which such facts are found regularly to recur under similar conditions.

It is easy to see that no private individuals could have power or authority sufficient either to collect such statistics on the proper scale or to prescribe the mode and forms of the schedules to be used for the purpose. It must be especially the work of Government, using the authority and resources of the nation, to make through its officials the needful researches. But previous to the formation of these congresses there was no similarity either in the division of the subjects or in the form of the documents. It was very seldom possible to compare together the results of an enquiry into the same subject in two different countries. Yet it is essential, if we wish to obtain the law which governs a certain class of events, to study its operations under different conditions and in different countries.

To take the subject with which in this Institute we are most familiar—the law of population—it will recur to every one that a few years back the statistics of mortality in different countries were scarcely ever given for the same combination of ages, nor were the censuses taken at the same interval of time. In the schedules of the census the same facts were not asked for. It was impossible to compare the emigrations from one state with the arrivals in another. The divisions of labour and of occupation were wholly different, and so many other points were left in obscurity or presented in such different ways that very little was gained by endeavouring to trace the causes of growth or decrease of population by bringing together the statistics of different countries. But within the last fifteen years a very great improvement is perceptible in the population returns of all European countries, and though much remains to be done to produce uniformity, the effect of these periodical meetings is seen in every new census which appears.

It is principally to M. Quetelet, to whose writings, eminent position, and incessant labours the study of statistics owes already the position of a science, that we are in a great measure indebted for the success of these congresses. The first, which was held in Brussels in 1853 under his auspices, formed the model of the rest. Called by the Government, who first sent invitations to the Governments of other countries, its most important feature was then and always will be the part taken by the official delegates in discussing the resolutions and seeing them carried into effect. But it was then wisely determined to include in the invitations a considerable number of scientific men, or those who had studied the special subjects to be discussed, so as not only to secure the actual practical effect of the conclusions arrived at, but to get them

recommended as based upon the largest possible experience, and, in some points at least, the agreement of men of the most divergent views.

The second congress was held in Paris in 1855, the third in Vienna in 1857, the fourth in London in 1860, and the fifth in Berlin in 1863.

At the close of the latter congress, several invitations were presented by the delegates in the names of their Governments for the next meeting, and it was left to the organization commission to decide the question, which they did in favour of Italy, and the city of Florence. A commission comprizing some of the most eminent Italian statesmen and men of science was thereupon nominated under the presidency of the Minister of Agriculture, Industry, and Commerce; and the King, Victor Emmanuel II., to mark the interest which he took in the successful progress of statistics, appointed his eldest son, Prince Humbert, of Savoy, President of the Congress.

The great political events of 1866 deferred the meeting till the present year, when its success was marked by having a larger number of members than any of the previous congresses. No less than 632 natives, and 85 foreigners, total 717, attended. In London, which was the next largest meeting, there were 505 natives and 90 foreigners, including in the former, the representatives of our colonies, total 595.

The Minister of Agriculture, Industry, and Commerce opened the commission by a lucid address on the subjects to be studied, the necessity of clearness and precision in stating them, and the aim and object of obtaining uniformity in statistical returns.

Dr. Pietro Maestri, the director of the Royal Statistical Bureau of Italy, whose able writings have made him honourably known throughout Europe, was indefatigable both by his reports and personal labours in preparing the programme for discussion, and he contributed largely to the success of the congress.

The question of the programme was rather a difficult one. In the five previous meetings so many subjects of public utility had been discussed and settled by resolutions, that he wisely advised keeping in a great measure to those questions which, having been only slightly debated or deferred for further consideration, left a fair legacy of work from previous years. To these, however, he added various questions which had been proposed in a special correspondence with the chiefs of the statistical departments of other Governments, and which involve some of the most important

questions of the day, such as agricultural statistics, money and financial credit, the joint publication of statistics of all countries, and their transmission free of expense between the Governments, physical and moral statistics, interior commerce, improvement in the registers of population, &c.

Besides these useful reports Dr. Maestri undertook a most important labour in carrying on an admirable work prepared by Dr. Engel for the congress at Berlin, being an index and summary of all the matters treated of and resolutions passed at all the previous congresses. From the great variety of matter and numerous subdivisions of each subject it would be impossible to avoid useless repetitions of some and serious omission of others; unless a good index could be formed of all that has been done as well as of what has been commenced but left unfinished. Dr. Maestri has merely extended Dr. Engel's plan, so as to include the resolutions and labours of the Berlin congress; but it may be imagined what suggestive matter it contains and what a variety of details must be contained in the original programmes of each congress when a mere index to five of them occupies a thick quarto volume of 330 pages. It includes also a synopsis of the reports presented by the official delegates on the condition of statistics and statistical studies in their respective countries, as well as of the classes of the members and of the literary works that were presented at each congress.

With these materials for preparing the programme, the committee appointed for the purpose was divided into eight sections, to which the following subjects were confided:—

#### Section I.—Theory and practice of statistics.

1. Re-organization of the International Congress.
2. Constitution of official statistics.
3. Legal population of states—*i.e.*, of natives absent from the country as well as those present at the time of the census.
4. Laws of mortality and normal tables for assurance societies.
5. Uniform nomenclature for statistics.

#### Section II.—Topography.

1. Organization of meteorological stations and formation of a daily chart for all Europe.
2. Nature, ownership, and regulations for the supply and use of water. Water for drinking, for irrigation.

Section III.—Agrarian statistics.

1. Valuation of the net revenue of cultivated lands and value of products.
2. Economy of the Credit Foncier (land loans).
3. Statistics of cattle—production, importation, exportation.

Section IV.—Statistics of communes.

1. Constitution as to boundaries and economical condition of communes.

Section V.—Statistics of monetary circulation and paper currency.

Section VI.—Moral and judicial statistics.

1. The poor classes—mendicants in the streets and at church doors, people admitted into workhouses, nocturnal and similar asylums, tramps, juvenile offenders, liberated convicts, prostitutes.
2. Uniform rules for collecting in the different countries of Europe statistics of the domestic relations of families (such as guardianships, divorces, &c.)
3. Statistics of bankruptcies and the effects of different systems of legislation on commercial credit.
4. Statistics of restraint of personal liberty in civil and commercial matters.
5. Statistics of the causes of crime.
- 6 Statistics of offences against military and naval discipline and their punishments, in order to be able to form a comparison of the moral condition and discipline of the various armies and naval forces of different countries, and of the efficacy of the means of repression used.

Section VII.—Military statistics.

1. Health and mortality of the civil and military population.
2. Enquiries as to the food, dress, equipment, lodging, and service of the military and naval forces.
3. Gymnastic exercises.
4. Forms of schedules concerning the physical condition, invaliding, and mortality of the military and naval services.
5. Classes of disease in reference to duration of service.

Section VIII.—Education.

1. Schools of fine art, museums, archives, or collections of public documents, libraries.

Reports upon all these subjects so important and of such varied interest, were prepared by different members of the eight sections

to constitute the total programme. Amongst the writers will be found the names of some of the most eminent authors and thinkers, whether Italians or other members of the congress. In the first section are found Messrs. Visschers, Berg, Correnti, and Anziani, Brioschi and Maestri. In the second Professor Cantoni wrote on meteorology; and a long and very elaborate report on hydrography appears by S. Pareto. Agricultural statistics employed the pens of S.S. Rabbini, Restelli, and Lampertico. Currency and money and unity of weights and measures were treated in an able report by S. Allievi. The subjects of the sixth section were discussed by Dr. Maestri and Professor Messedaglia, of the seventh by S. Baroffio, and the greater part of the eighth by the indefatigable Dr. Maestri and others.

I do not propose to give an account of the discussions on this wide range of subjects, however important most of them are to every man who is watching the great social questions of the day, but briefly to describe the method of proceeding, and state the conclusions arrived at on one or two of the questions which are likely more especially to interest the members of this institute.

For two days before the Congress, preliminary meetings of the foreign delegates were held under the presidency of M. Quetelet, at which the question of the free transmission of official statistical documents was referred to a special committee. Resolutions were also passed in favour of a cheap annual *résumé* in each country of its principal official statistics, with a comparison of the same in previous years somewhat in the form of the English "Statistical Abstract;" also of publishing an annual index with details sufficient to give a clear idea of the contents of all the documents printed by the Government during the year.

The Congress was formally opened on the 29th of September by a short address from the Minister of Agriculture, S. De Blasius, in which, after alluding to the ancient renown of Italy in learning and the arts and the wide field for the cultivation of statistical studies which the recent union of nearly all its provinces into one opened up, he welcomed in cordial terms the many distinguished foreigners in the name of the Government and Italy itself. The Government delegates of foreign countries were then elected vice-presidents, several secretaries were appointed for different languages, though it was understood that Italian and French were to be generally used in the public discussions, and the members separated into the different sections to discuss the parts of the programme allotted to each.

At the second session on the following day, the Minister of Agriculture in a long discourse pointed out how the reforms in all branches of the Italian administration had led to the appointment of Parliamentary commissions for statistical researches in every state question, of the results of which he had ordered a complete collection to be laid before the Congress. He pointed out with justice how liable statistics are to be collected in aid of a particular interest or prejudiced view, instead of being based upon general and sound principles. In the annual and quarterly Government publications will be found most striking details of the effect of improvements in Customs, laws, in railways and roads, telegraphs, and other means of social progress in Italy. He concluded by showing the immense advantages attending uniformity of observation, so as to compare the same classes of facts amongst different nations, and the great benefits which a congress moving about for this object is likely to confer on all countries where it assembles.

Amongst the subjects discussed in the sections was a report by S. Allievi on uniformity of weights and measures in all countries, on which the resolutions introduced by an eloquent speech by M. Wolowski, a distinguished member of the Institute of France, were carried unanimously. They were to the effect that this Congress, confirming what had passed in all the previous congresses, recommends the universal adoption of the metric system; that to aid its progress associations should be formed in each country where it is not yet adopted, to make known its advantages; that the International Decimal Association in London should, from correspondence with these societies, obtain the materials for a report to be made at the next Congress on the advances made and the difficulties which have been or have to be overcome in its progress; that it should form in all countries a part of the instruction in Government and other schools, and that the other means recommended in M. Jacobi's report should be adopted for its extension. However much patriotic motives may encourage the adoption of an isolated system for each country, there can be no doubt of the immense facilities which a uniform decimal system would give to commerce and national intercourse, and none who have studied the subject will deny the extreme simplicity of the metric system in use, and the time and mental labour it would save in the education of youth. Weight and measure are surely cosmopolitan. Why should the instruments for computing them make them merely local?

A further proposition on this subject was adopted at the sixth



session, that the chiefs of departments should prepare for the next congress a table of the weights, measures, and coins used in their own country, with their reduction into those of the other principal states.

As to the almost equally important but more difficult subject of international money, the Congress confined itself to approving the adoption of any suitable means to extend the principles of the Monetary Convention of Paris, 23rd December, 1865. In the meantime it was decided to recommend to the official departments of states to collect all the statistics of gold production and of coinage in uniform schedules.

Passing over the resolutions on hydrography introduced by S. Pareto; on agricultural statistics, especially the supply of animal food, by S. Lampertico; of meteorology, by S. Cantoni, and the other subjects referred to the sections, all of which gave rise to animated discussions, but which were finally adopted, and an important discussion on the permanent organization of the congress, which ended in deferring the whole question till a further congress should think fit to resume it, I draw attention to a very admirable work presented by M. Quetelet. This was a publication of statistics relating to the population of different states. With the co-operation of the Directors of the Statistical Departments of other Governments, and by the efficient aid of M. Heuschling, of the Statistical Commission of Belgium, it comprised the principal tables of population, deaths, births and marriages brought together as nearly as possible to the same period, about the year 1861. It was the result of a proposition made by M. Quetelet himself to the congress at London, and had been printed at the expense of the Belgian Government. Though considered only as an essay, it had been so favourably received that he proposed to continue a similar work in other branches of enquiry. It must be admitted that this is indeed a most important beginning, not merely because it contains the summaries of several large volumes in a form suitable for computing the percentages for comparison, but because the information may be accepted as the most authentic that can be obtained. It is to be hoped that M. Quetelet will be able very soon to extend his plan, especially to the statistics of commerce, law, crime, and finance.

Another most important proposition was also made by the same eminent authority, and unanimously adopted by the first section, and afterwards by the Congress, that "considering the importance and extension of statistical questions to which mathe-

matics may be applied, and that in all civilized nations some illustrious geometricians have made the application of the doctrines of probability to such subjects their special study there should at the future congresses be a particular section to consider statistical questions in their direct relation with the theory of probabilities." I need hardly point out to the members of this Institute how clearly this resolution recognizes our own objects and pursuits, and how much we owe one of the most eminent of our honorary members for the high position which he thus incidentally claims for us.

In regard to other questions of population, the seventh section, which was presided over by Dr. Graham Balfour, sent in propositions as to the sanitary condition of military and naval forces, including enquiries into their diseases and mortality, according to locality, age, and duration of service, medical treatment and surgical operations, the care of the wounded in time of war, &c. From the great value of the reports on the foreign military stations of the British army, which for so many years have been prepared by the care and talent of Dr. Graham Balfour, it is easy to perceive what great additions to our knowledge of the effects of climate on health would be gained by a comparison of such statistics in every country.

The resolutions on the subject of laws of mortality and normal tables for assurance societies introduced by S. Brioschi in a very interesting memoir in the programme were carried, thus :—

1. That the Congress considers it desirable that each government should publish normal tables corresponding to the operations of the different classes of life assurance societies, which being corrected and re-published whenever the original mortality tables are revised, may serve as guarantees of safety to the public.

2. That the Governments should obtain the experience of the assurance companies so far as concerns the mortality amongst their members, and publish the results.

In the debate on this subject S. William Rey, director of the Reale Life Assurance Company at Milan, and who has recently published a new and valuable series of Mortality Tables for North Italy, graduated according to the Gompertz theory, made a very effective speech.

It will be observed that these proposals do not involve the large and very difficult question, whether it is to the advantage of the public that Government should undertake assurance business generally, and as the publication of any information that can be

obtained must benefit science, it is to be hoped that these resolutions will be practically carried into effect.

Some general propositions to obtain a common language for statistics, that is, that in all publications the same terms should have the same definite meanings, were passed, and it was referred to the chiefs of statistical departments in each country, to consult and agree upon a uniform nomenclature, and in all documents to define the old as well as the newly recognized meaning of the term. Anyone, for instance, who has had to study criminal statistics will admit the great difficulty of comparing the statistics of crimes and punishments from the very different meaning which the same word conveys, not merely in different countries, but in the different provinces and divisions of the same country. This is to cite but a very small part of the difficulties of the subject, but it shows the absolute necessity of agreeing in all cases to some terms conveying the same and definite meanings. At the previous congresses, great progress had been made in a similar process by agreeing to names common to all countries under which the causes of death in the tables of mortality may be classified. In this useful labour Dr. Farr has taken a very prominent part.

It would occupy too much time to detail all the other resolutions or to give a *resumé* of the debates. I have only stated those which appeared to me most likely to attract your attention. After a week's sittings the congress was closed by a short address from his Excellency the Minister of Agriculture, S. De Blasius, in which he gracefully alluded to the great advance made by the labours of the members and his hope that whilst Italy would profit by the new knowledge she had gained, the distinguished strangers on their return would bear a pleasing remembrance of the meeting and of the earnestness with which Italy was entering upon the highest studies of practical life and of strict intellectual truth.

Indeed every one there present must feel that a tribute is due to the hospitality and courtesy which they received from all sides. His Majesty the King of Italy received the foreign delegates at the Pitti Palace, and after apologizing for the absence of his eldest son, the Prince Humbert, who was detained by urgent affairs at Paris, invited them all to a grand banquet which was given at the close of the congress. The President of the Ministerial Council, S. Ratazzi, and the Minister of Agriculture, gave a grand reception in the ancient and historical Palazzo di Podesta, now converted into a national museum of rare antiquities. The syndic and municipality of Florence invited the members to the municipal

palace on the Cascine and to a musical entertainment in La Pergola, and the Marquis di Pepoli, as syndic of Bologna, offered them the hospitality of that renowned city. From all classes, eminent statesmen and learned professors from all parts of Italy, and above all from Dr. Maestri, the chief of the Statistical Department, and to whom the congress owes so much for its success, the most courteous and hearty attentions were received.

I will conclude by observing that, though our mere professional pursuits only comprise a small part of the varied and most important topics to which I have alluded, the same theory of probabilities on which they are based is capable of application to many of the others. Knowledge always repays the toil by the pleasure itself of its acquisition. Still more must this be the case when the mind is given to subjects in which the health and happiness of thousands is involved and the progress of civilization advanced. If, therefore, when the members of this Institute have thoroughly grounded themselves in the knowledge of their profession, they should be disposed to extend the application of their science to some of the questions of which such a wide field of view is here opened up, they will have the satisfaction of knowing that in abolishing error, prejudice, or ignorance, they are using the basis of their professional skill for the good of their own community and the social progress of nations.

*On the final law of the sums of drawings.* By A. DE MORGAN, ESQ.

LET there be letters  $x, y, z, \dots$  each of which has values, choices, or drawings. Let their number be  $\sigma$ , and let,  $\xi, \eta, \zeta, \dots$  be their several numbers of drawings:  $x_1, x_2, \dots, x_\xi$  the drawings of  $x$ ; and so on. Let  $\Sigma x, \Sigma y, \dots$  be the sums of the drawings of  $x, y, \&c.$ ; and  $\Sigma :x, \Sigma :y$ , the average drawings: so that  $\Sigma :x = \frac{1}{\xi} \Sigma x$ , and so on. Let any drawing of one letter be compatible with any drawings of the others: so that the terms of the product  $\Sigma x. \Sigma y. \Sigma z$  contain every joint drawing of  $xyz$ . The number of drawings of  $xyz$  is  $\xi\eta\zeta$ : and  $\Sigma(xyz) = \Sigma x. \Sigma y. \Sigma z$ . Dividing both sides by  $\xi\eta\zeta$ , we have  $\Sigma : (xyz) = \Sigma :x. \Sigma :y. \Sigma :z$ . The same holds for any number of letters, or powers of letters: and thus we have the following theorem:—All possible combinations of drawings being taken into account, the average of all the